REMARKS

This paper is filed in response to the Final Office action mailed on November 27, 2007. Claims 63-90 are presented herewith. Applicant appreciates the Examiner's allowance of claims 85-88 and his indication that claims 65, 67, 71, 73, 76, 78, 82, and 84 recite allowable subject matter. In view of the foregoing amendments and following comments, Applicant respectfully requests reconsideration and allowance of all pending claims.

Claims 63, 74, 89, and 90 stand rejected under 35 U.S.C. 103(a) as obvious over U.S. Patent No. 5,671,608 ("Wiggs") in view of U.S. Patent No. 6,390,183 ("Aoyagi"). Applicant respectfully traverses this ground of rejection.

Independent claim 63, as well as claims 64-67 depending directly or indirectly therefrom, specifies a method of designing a direct expansion geothermal heat exchange system comprising providing an exterior, subterranean heat exchanger and circulating an R-410A refrigerant through the exterior heat exchanger.

Independent claim 74, as well as claims 75-78 depending directly or indirectly therefrom, specifies a direct expansion geothermal heat exchange system comprising an exterior, subterranean heat exchanger and R-410A refrigerant disposed in the exterior heat exchanger.

Independent claim 89 specifies a method of designing a direct expansion geothermal heat exchange system comprising providing an R-410A refrigerant and utilizing the R-410A refrigerant in the refrigerant heat exchange tubing of a direct expansion geothermal heat change system wherein the refrigerant heat exchange tubing extends to depths of approximately 100-300 feet below the surface.

Independent claim 90 specifies a direct expansion geothermal heat exchange system comprising an R-410A refrigerant and refrigerant heat exchange tubing positioned approximately 100-300 feet below the surface.

The proposed combination of Wiggs and Aoyagi fails to disclose or suggest a direct expansion geothermal heat exchange system having a below surface heat exchanger or heat exchange tubing and an R-410A refrigerant. The primary reference to Wiggs discloses a direct expansion system using conventional refrigerant, and therefore fails to disclose or suggest the use of R-410A refrigerant, as acknowledged in the Office action.

The secondary reference to Aoyagi fails to disclose or suggest use of R-410A refrigerant in a direct expansion system, and therefore the proposed combination of Wiggs and Aoyagi fails to disclose or suggest the subject matter specified in independent claims 63, 74, 89, and 90.

As an initial matter, Applicant notes that the system disclosed in Aoyagi is a conventional air-source heat exchanger, instead of a geothermal direct expansion system as currently claimed, and therefore its mere disclosure of R-410A refrigerant for use in an air-source heat exchanger would not motivate one of ordinary skill in the art to use that refrigerant in a geothermal direct expansion system. Instead, Aoyagi teaches the use of a secondary tube insertion into the interior of finned tubing within a conventional air-source heat exchanger, so as to allegedly restrain the evaporation ability from lowering while restraining pressure loss (in the heating mode). See Column 3, lines 26 – 33. The Aoyagi device is further provided to reduce the thickness of the liquid within a conventional air-source heat exchanger by providing an insertion tube that provides additional interior surface area for condensation (in the cooling mode), that enhances (increases) the current flow (of the refrigerant), and that reduces the requisite refrigerant charge volume. See Column 3, lines 34 – 48. The apparatus disclosed in Aoyagi, while, while allegedly beneficial in an air-source system design which incorporates finned heat exchange tubing, is not advantageous in a DX system that does not utilize finned heat transfer tubing. This is because, in a DX system, particularly with vertically oriented heat exchange tubing, the surrounding ground, which does not move, has a limited ability to either supply or absorb heat, depending on the BTU/Ft.Hr. Degrees F heat transfer rate of the surrounding geology. An air-source system does not have such a restriction, as the air is constantly flowing around the heat exchange tubing. Thus, in a DX system, if one restrains the evaporation ability in the heating mode, or if one increases the refrigerant current flow in the cooling mode, the design capacity output (in BTUs) of the system for any particular geology will be impaired as the surrounding geology can only provide, or absorb, so much heat per lineal foot of sub-surface heat exchange tubing, so that the provision of air-source type finned tubing is generally inconsequential. Thus, the alleged advantages taught by Aoyagi would be counterproductive in a DX system design, and would generally not be realistically considered by a DX system designer. Therefore, Aoyagi's mentioning R-410A, in conjunction with other refrigerants, for use with his air-source system design would not motivate one of ordinary skill in the art to use R-410A in a DX system.

Aoyagi further teaches away from the primary benefit of using R-410A in a direct expansion geothermal system, thereby further discouraging one of ordinary skill from making the proposed combination. Testing by the Applicant has demonstrated improved DX system performance because of its increased operational pressures, particularly at depths in excess of 100 feet. To the contrary, Aoyagi does not teach using R-410A so as to provide increased system operational pressures in his air-source system design or in any other system design. Instead, Aoyagi expressly teaches "restraining pressure loss" (Column 3, line 29), which would obviously mean lessening pressure loss, as opposed to increasing operational pressures, and Aoyagi teaches "reducing the amount of refrigerant to be charged by reducing the volume in the heat exchanger tubing" (Column 3, lines 44 – 48). Consequently, one of ordinary skill in the art would be led by Aoyagi to reduce the system operational pressures, as opposed to increasing operational pressures (as taught by Applicant herein). Aoyagi alleges that a refrigerant (naming R-410A and others), with alleged higher densities than R-22, has a lower current speed which lowers pressure loss to about 70%, which allegedly enhances heat transfer. See Column 5, lines 62 – 67, and Column 6, lines 1 – 3. Lowering pressure loss is not teaching the use of a refrigerant because of its overall higher operational pressures. Again, via teaching the reduction of refrigerant charge in conjunction with lowering pressure loss, Aoyagi actually teaches away from increasing overall system operational pressures, which is one of the primary benefits of using R-410A in a direct exchange geothermal system.

Still further, Aoyagi does not teach the use of R-410A refrigerant for overall higher operational system pressures in a DX system design, or in any system design that does not have a tube with the tubing of the heat exchanger, whether finned or not. Placing a tube within the heat exchange tubing of a DX system would also be realistically cost prohibitive, in addition to being ineffective. In a DX system, evaporation and condensation generally solely occur on the interior of the refrigerant transport tube surface directly adjacent to the surrounding geology, not within the interior of the refrigerant transport tubing, whether or not a tube is placed within the primary heat transfer tubing shell. Further, as mentioned, the geology surrounding a DX system's sub-surface heat exchange tubing is generally not fluid, as is the air, and the exposure of a DX system's unfinned tubing itself to the geology is typically sufficient so as to maximize the geology's heat transfer abilities. Thus, the utilization of R-410A refrigerant, so as to increase

overall system operational pressures, would not be obvious for use in a DX system design, as taught by the Applicant herein as the result of actual and extensive field testing.

The Examiner's allegation, on page 2, that Aoyagi teaches the use of R-410A in a heat exchanger for the purpose of enhancing heat transfer coefficient and to protect the ozone layer is only partially correct. The Examiner is correct in that R-410A is one of a multitude of refrigerants that helps protect the ozone layer (some of which have one of similar, lower, and greater operational pressures than R-22, as has been well understood by those skilled in the art prior to Aoyagi's patent application). Protecting the ozone layer is a good thing, but has no bearing on the Applicant's subject disclosure regarding the utilization of R-410A in a DX system application in a manner so as to actually increase overall system operational pressures. However, the Examiner is incorrect in asserting the use of R-410A was taught by Aoyagi as a means of enhancing heat transfer. Enhancing heat transfer was primarily alleged by Aoyagi to be accomplished by inserting a tube (or a tube bundle) within the interior of finned tubing within a heat exchanger, as explained herein (also see column 6, lines 11 – 44). This premise (the fluid flowing in the flow passage in "the heat exchanger tube") was the basis for Aoyagi teaching the use of R-410A and other refrigerants (see Column 6, lines 41 -44). Aoyagi's heat exchanger tube has a tube, or a tube bundle, within the primary finned heat exchanger tubing of an air-source heat pump. The Examiner's allegation that Aoyagi taught that R-410A alone enhances the heat exchange coefficient is incorrect in that the Examiner overlooks the stated premise for the use of R-410A, where Aoyagi states, at Column 6, line 45, for example, "According to this construction…" "this construction" clearly having been identified as a tube or tube bundle within the interior of an air-source heat pump's finned heat exchange tubing. Therefore, the motivation for combining the references as stated in the Office action is incorrect.

Turning to claims 68 and 79, those claims are also rejected under 35 U.S.C. 103(a) as obvious. It is unclear from the Office action as to what art is asserted against claims 68 and 79, so the following comments assume that a combination of Wiggs and Aoyagi has been applied. Applicant traverses this ground of rejection.

In making the rejection, the Examiner rejects claims 68 and 79 by asserting that the range of operating pressures between 50 psi and 180 psi are not new. As is well understood by those skilled in the art, however, in a 50 to 180 psi operational range, 50 psi refers to the low pressure

side of the system and 180 psi refers to the high pressure side of the system. Thus, the claimed system operational pressure of 80 psi (low pressure side) to 405 psi (high pressure side) is not taught or suggested in the prior art. Further, Applicant's testing has demonstrated that such a new, and higher pressure, DX system operational optimizes DX system operation when sub-surface heat exchange tubing has been installed at depths between 100 and 300 feet.

In view of the foregoing, claims 63, 68, 74, 79, 89, and 90 are patentable over the cited prior art. Furthermore, claims 64-67, 69-73, 75-78 and 80-84 which depend therefrom are similarly patentable.

CONCLUSION

It is submitted that the present application is in good and proper form for allowance. A favorable action on the part of the Examiner is respectfully solicited. If, in the opinion of the Examiner, a telephone conference would expedite prosecution of the subject application, the Examiner is invited to call the undersigned attorney.

The Patent Office is hereby authorized to credit any overpayment or charge any deficiency in the fees filed, asserted to be filed, or which should have been filed herewith to our Deposit Account No. 50-3629.

Respectfully submitted,
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